

RADIATION DAMAGE CAUSED BY SHOE-FITTING FLUOROSCOPE

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Within recent years attention has become focused on the potential risk of radiation damage due to fluoroscopic shoe-fitting.^{3 5 7 8 12} However, owing to the long interval between the exposure to radiation and the occurrence of damage, the possible influence of other aetiological factors can very rarely be excluded.

A case of x-ray dermatitis caused by a shoe-fitting fluoroscope is here reported.

Case History

A woman aged 56 gave a history of sciatica in 1950, with pain radiating to the right leg. She has since occasionally had mild lumbar pain on bending forward. In 1952 she had acute anterior poliomyelitis with paralysis of the left leg; paresis of the dorsal flexors of the left foot persisted. In 1953 she had a dislocation fracture of the atlanto-epistrophic articulation after falling on her back down ten stairs. No medullary symptoms were present. In 1954 she had cholecystectomy.

During 1950-1 a few telangiectases occurred on the medial aspect of the right hallux. There has since been slowly progressive exacerbation. The affection has spread laterally across the dorsal surface of the foot, where the skin has become atrophic, with fine scaling, depigmentation, and a network of telangiectases. As the patient had no subjective troubles she did not seek medical advice until 18 months ago, when ulceration occurred medially under the nail of the right second digit, with no tendency to heal under various local treatments.

On examination the skin of the medial and dorsal aspects of the right hallux and, to a decreasing extent, of the dorsal aspects of the second, third, and fourth digits presented cicatricial changes, with keratotic scaling, numerous netlike telangiectases, and depigmentation. The soft tissue of the first and second digits was indurated. The nails of the first, second, and third digits were thickened and partially detached. Medially under the nail of the second digit there was a pea-sized ulceration with pale pus-covered granulations. The skin of the right fifth digit was normal, as was the skin of the left foot. Neurological examination revealed sequelae of acute anterior poliomyelitis with paresis of the dorsal flexors of the left foot. No signs of systematic organic nerve lesions were found (E. Franzen). X-ray examination of the lumbar spine showed degeneration of

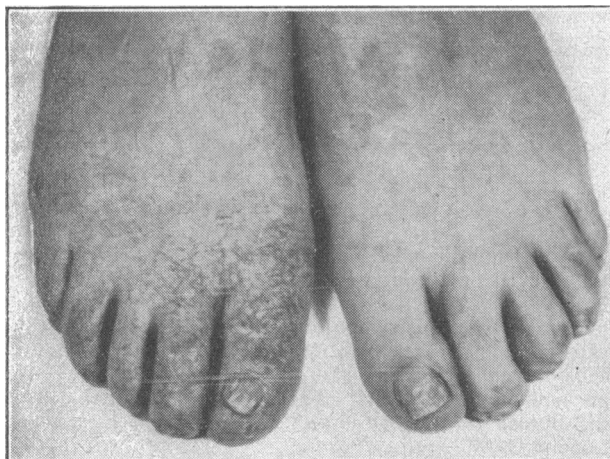


FIG. 1.—Typical x-ray dermatitis of right foot.

the disks of the fourth and fifth lumbar vertebrae. X-ray examination of the feet revealed no abnormalities. Oscillometry showed smaller oscillations of the left lower leg than of the right (though both were within normal limits). Blood examination disclosed nothing abnormal.

The clinical picture was one of typical x-ray dermatitis (Fig. 1), but the patient's feet had allegedly never been submitted to radiation treatment or to x-ray examination. On inquiring for other possible chances of exposure to radiation we were informed that the patient had been occupied for about 10 years in a shoe shop where a shoe-fitting fluoroscope was used. The fluoroscope operated by the patient and a similar apparatus in the same firm had been withheld from the compulsory control of the physicist of the Danish Health Directory.

The Shoe-fitting Fluoroscope

Fig. 2 illustrates the shoe-fitting fluoroscope. The x-ray tube (F) is mounted in a box at the floor of the fluoroscope. Except for a field in the roof corresponding to the

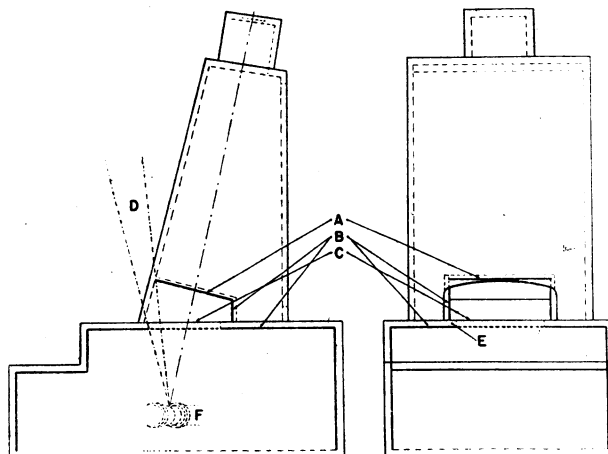


FIG. 2.—Lateral and anterior views of shoe-fitting x-ray fluoroscope.

footplate (C), the box is lined with lead sheets 2-mm. thick (B). The customer stands on the footplate (C) during the transillumination. The image appears on the fluorescent screen (A), screened superiorly by a lead-glass plate, 2.1 mm. thick, from which lead sheets 2-mm. thick extend posteriorly and laterally down to the lead sheets lining the box. The fluoroscopic image can be viewed simultaneously by the shop assistant, the customer, and a third person, through three openings above.

In both fluoroscopes the voltage in the tube was rated at 46 kV and the current intensity at 2-3 mA. It could not be elucidated to what extent the primary beam of x rays was filtered. The transillumination time was originally 10 seconds. As, however, this was found to be too short for proper orientation, the time was altered to two minutes. For shorter transillumination the supply of current to the fluoroscope was cut off.

Both fluoroscopes were examined by the physicist of the Danish Health Directory, Mr. P. Rønne-Nielsen, who reported the following results of measurements: In fluoroscope No. 1 the beam intensity at the foot-plate was measured at 9.2 r a minute. In fluoroscope No. 2 the intensity at the corresponding place was 13.2 r a minute. At E (Fig. 2) a defective lead screening was found: one lead sheet adjoined another without overlapping, so that a narrow beam of x rays could penetrate, which, owing to the wooden covering, exposed the shop assistant to strong diffuse irradiation while she was operating the fluoroscope. From the front part of the foot-plate a non-screened cone of rays passed in the direction of the customer's abdomen (Fig. 2 D). The beam intensity was of the order of 1 r a minute in adults, while it might be considerably greater in children, being inversely proportional to the square of the distance from the source of radiation.

Discussion

The present case of x-ray dermatitis with ulceration showed that the patient had in the course of years received very large doses of x rays on the right foot. The chances of exposure to radiation were as follows: (1) The patient operated the shoe-fitting fluoroscope 15 to 20 times daily. While doing this she was standing on the floor to the left of the fluoroscope, where the feet were exposed only a little. However, if, during the transillumination, she supported her right foot on the platform in front of the foot opening it was exposed to intense irradiation. (2) New shoes bought were always fitted by transillumination. (3) If children were afraid of the transillumination the patient would now and then put her foot into the apparatus to show that "it did not hurt" (this did not happen every day, however). (3) If there were no customers the shop assistants would occasionally try new shoe models under transillumination.

The site and development of the x-ray dermatitis of the right foot show it to have been due mainly to the first-mentioned chance of exposure.

Preliminary investigation by Stewart *et al.*⁹ have shown that x-ray examination of the abdomen of a pregnant woman may provoke leukaemia or cancer of the foetus. On repeated and possibly prolonged transilluminations in these shoe-fitting fluoroscopes pregnant customers will have received considerable doses of x rays against the abdomen.

The increasing use made of ionizing rays within industries and in medicine will expose a steadily rising number of people to an irradiation of the gonads greatly exceeding that which these receive from the natural background radiation (radiation from radioactive substances in soil and organism, as well as cosmic radiation). Any form of ionizing radiation is mutagenic. There is no lower limit to the dose of rays provoking mutations, and the number of these will ostensibly rise proportionally to the dose received by the gonads.¹¹

To counteract the increasing risk of radiogenic damage thus involved, preliminary investigations have been made to assess to what extent different sources of radiation raise the radiation dose to the gonads. Various writers⁶⁻¹⁰ agree that medical use of ionizing rays is the main factor in this rise.

In the Frederiksberg Hospital⁸ 19,000 x-ray examinations are carried out each year, of which 7,578 are grouped round the pelvis. Apart from salpingographies and x-ray examinations in pregnancy and sterility (216 patients), the age incidence shows a maximum for age group 50 to 70 years. In the Roskilde County and City Hospital¹ 7,586 patients were in 1955 submitted to a total of 12,800 x-ray examinations. Only 860 patients under 46 years of age had examinations made involving the gonads. By a good technique the dose can generally be kept as low as 1 or 2 r per examination. Hammer-Jacobsen⁴ has calculated the radiation dose received by the gonads in the Danish population from diagnostic radiology to be 122,313 r a year, corresponding to 29% of the dose received from the natural background radiation.

Roughly 60,000 transilluminations were carried out annually with the two fluoroscopes. The transillumination time was 30 to 45 seconds. During this period a non-screened beam of rays passed from the front part of the foot platform to the direction of the customer's abdomen. In adults the beam intensity was of the order of 1 r a minute, while in children it might be much higher. It is seen that a single defective shoe-fitting fluoroscope will raise the total radiation dose to the gonads much more than even very large radiological units. In assessing the genetic hazards only irradiation of fertile individuals is to be considered. This fact adds still further to the difference, because shoe-fitting fluoroscopes are used chiefly for child customers, whereas x-ray examinations comprise mainly elderly individuals.

The genetic hazards of increased gonad radiation being uncertain, it is necessary to compare the value of the use of each source of radiation with the possibility of increased

risk. Owing to the great danger involved by the use of shoe-fitting fluoroscopes there is reason to examine whether correct measuring and trying on do not fulfil the requirements of exact fitting of shoes, so that these fluoroscopes might be prohibited.

Summary

A case is reported of x-ray dermatitis with ulceration caused by a shoe-fitting fluoroscope.

The physicist's examination of the apparatus revealed that during transillumination of the feet a non-screened beam of x rays passed from the front part of the foot platform in the direction of the customer's abdomen. The rise of the radiation dose to the gonads caused by such a defective fluoroscope is much greater than that from even large radiological units.

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ORAL TREATMENT OF DIABETES WITH TOLBUTAMIDE

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Bänder *et al.* (1956) reported the successful therapeutic use of tolbutamide (D.860, "rastinon") in selected diabetic patients. The following clinical study was designed to ascertain the effect of the drug in Indian patients, and covers the period from August, 1956, to June, 1957.

Material

A total of 137 cases of established diabetes mellitus were treated (108 males, and 29 females). The age incidence was 27 to 76 years, excluding a child of 4 years with congenital diabetes. In 30 cases the disease was hereditary. The known duration of the disease ranged from 1 to 27 years. According to the standards set by the Metropolitan Life Insurance Company Statistical Bureau, quoted by Dunlop *et al.* (1953), 10 patients were asthenic, 64 were of ideal weight, and 63 were obese. Of the 105 patients who had symptoms of diabetes of varying severity, 46 had shown evidence of acetonuria some time or another, but only 17 of them were liable to ketosis within two to seven days of withdrawal of insulin therapy.

The cases were classified as "mild" (28 cases), "severe" (97 cases), and "very severe" (12 cases) on the basis of results of initial glucose-tolerance tests. In the mild cases the highest blood-sugar level was below 250 mg./100 ml., in severe cases it was 250 to 450 mg./100 ml., and in the very severe cases it was over 450 mg./100 ml. 82 cases had been taking insulin regularly.

Methods

Before starting oral antidiabetic therapy clinical examination was made of all patients, and their latest diabetic state was evaluated by means of a glucose-tolerance test after removing all dietetic restrictions and withdrawing